DOCUMENT RESUME

ED 424 317 UD 032 580

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TITLE When Low SES Parents Cannot Assist Their Children.

PUB DATE 1998-04-00

NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Diego, CA, April 13-17, 1998).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Educational Attainment; Grade 7; Helping Relationship; *Junior High School Students; Junior High Schools; Low Achievement; *Mothers; *Parent Child Relationship; Poverty; *Science Instruction; *Socioeconomic Status; Urban Youth

ABSTRACT

A study was conducted to determine some of the problems and characteristics of low socioeconomic status (SES) parents who have children with low science achievement scores relative to parents of higher achievers. Sixteen low-achievement seventh graders in an urban school and 16 high-achievement students participated, along with their mothers. Three science activities were assigned and the students' mothers were told that they could help at any time. Maternal interactions were coded. The overall dependence on the task directions that the low achiever/low SES mothers demonstrated may be an indication of their own developmental level or related to activity setting features. When parents confronted tasks beyond their own proximal development, they tended to use ineffectual mechanisms such as physical cueing or pushing directions to the child. Their actions were in sharp contrast to the elaborated verbal cues so easily used by the mothers of the high achievers. Much of the problem appeared to relate to the literacy level of the mothers. Implications for academic achievement and instruction are discussed. (Contains 2 tables and 46 references.) (SLD)

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When Low SES Parents Cannot Assist Their Children

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Paper Presented at the
1998 Annual Meeting of the
American Educational Research Association
San Diego, California
April 12-19, 1998

UD032580

In the cultural-historical (CH) model, intellectual performance that is assisted often by more expert systems is considered important in defining the future directions of development. The latter may be found in the zone of proximal development (ZPD) and are defined by (mental) "functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state" (Vygotsky, 1978, p.86).

Parent-child interaction (PCI) research, using small samples and with its emphasis upon the importance of adult guidance, is of strategic significance in addressing a number of questions regarding development and the role of culture in the structuring of the human mind (Radziszweska & Rogoff, 1988; Rogoff & Gardner, 1989; Wertsch, Minick & Arns, 1984; Valsiner, 1984 & 1987; Gauvin & Rogoff, 1989). Studies of parent-child interactions have generally attempted to unravel the role of parental teaching characteristics with respect to a variety of developmental outcomes (Farran & Haskins, 1980; Hess & Shipman, 1965; Laosa, 1981; Portes 1982 & 1988; Portes, Dunham & Williams, 1986; Rogoff, Malkin & Gilbride, 1984; Sigel & McGillicuddy-DeLisi, 1984; Wertsch, McNamee, McLane & Budwig, 1980). Analyses of the support systems in the ZPD have been conducted through the observations of adult-child dyads interacting during problem solving events (Brown & Ferrara, 1985; Collins, Brown & Newman, 1989; Griffin & Cole, 1984; Newman, Griffin & Cole, 1989; Palincsar & Brown, 1984; Portes, 1988, 1991; Radziszeweska & Rogoff, 1988, 1991; Rogoff, Malkin & Gilbride, 1984; Sigel & McGillicuddy-DeLisi, 1984).

A most useful way to understand the influence of context such as support systems on human development is the concept of activity setting (AS) which serves as a unit of analysis for

CH theory (Tharp & Gallimore, 1988). The activity setting may be defined by the personnel present, the motivations and purposes of the actors, the scripts used routinely, the task demands or operations of the activity, and the goals, beliefs and values involved (Gallimore, Goldenberg & Weisner, 1992; Tharp & Gallimore, 1988; Weisner, Gallimore & Jordan, 1988). This unit serves to describe how various environments might support the development of children. It also helps to integrate several lines of research in this area. Prior studies in this series have shown that general school achievement (Portes, 1982 & 1988) and science achievement ((Portes, Zady & Smith, 1994; Zady, Portes & DelCastillo, 1997; Zady, 1994) can be related to certain characteristics of social interaction found in teaching-learning situations or in the means of assistance evident in parent-child interactions. In this study, the main focus lies in tracing how the mother negotiates or fails to negotiate the task demands and scripts of school-like tasks in order to assist her child in problem solving. In observing the performance of the low-achieving/low-SES dyads, certain behavioral predictors of unsuccessful task completions were found. Parents of low achievers tended to use the printed directions in a concrete manner, e.g., reading the directions verbatim or closely paraphrased. Some physical dependence on the directions was also exhibited by low achievers' parents, e.g., pointing at the directions and pushing the directions at the child. In this study, a deliberate attempt is made to

measure parental dependence on the printed instructions. The purpose of the current study is to examine some of the problems and characteristics of low SES parents who have children with low science achievement scores relative to parents of higher achievers. In terms of assisting performance, implications for culture-sensitive interventions are drawn.

Method

Seventh-grade science teachers in a U.S. mid-south metropolitan school district were asked to distribute permission requests for the study. Eighty-nine students and their parents volunteered for the study and completed permission requests. The permission request called for volunteers to participate in the study, as well as in a classroom study (Zady, 1994). The form sought permission to obtain the results from the school district's most recent take of the California Test for Basic Skills (CABS). Normal Curve Equivalent (NCE) science and total achievement scores were derived. Thirty-two students were chosen for the study. Although every effort was made to obtain a representative sample from the pool of volunteers (N=89), it was difficult to find families of low achievers. Only one student with an NCE science score of less than 10 was available, and the next lowest score was 27. The strategy employed called for selecting the lowest sixteen science achievers from the volunteer pool and sixteen volunteers with NCE science scores of 70 or above. This decision, while risking spurious correlations, was made in order to gain a clearer conceptual picture of differences in interactions and cognitive supports. Thus, 16 students (6 male and 10 female) with low science achievement (Science NCE mean = 36.4), and 16 students (7 males and 9 females) with high science achievement (mean = 83.6) were selected. (Due to the aforementioned limitations, the sample represented the 2nd and 4th quartiles.) With respect to SES, efforts to overcome the achievement-level-SES confound were not successful, as there were also not that many students with high achievement and low SES. The median family income for high achievers was approximately $44,000 and $11,000 for low achievers. The average parental education levels were 13-16 years and 12-15 years respectively for each group.

After some warm-up questions centering around home science activities, three science tasks were assigned. Written instructions were given before each one, and the mother was told

that she could help at any time (without time limits). The tasks were arranged in order of increasing difficulty. The science tasks were representative of tasks found in various science education resources and of homework assignments (Boysen, 1990; Fredericks & Asimov, 1990; Inhelder & Piaget, 1958; Mullis & Jenkins, 1988; Newman, Griffin, & Cole, 1989; Rutherford, 1989, 1993; Skolnick, Langbort, & Day, 1982; Unesco, 1973; Vaidya, 1970).

The third and most challenging task involved the testing of acids and bases. The directions stated, in the first step, color solution (Universal pH indicator) was to be mixed with a tube of vinegar. The dyad was to record the color change.(It turned red.) The dyad was told on the direction sheet that vinegar was an acid. In the same manner, a tube of soda turned blue, and the dyad was told that soda was a base. The dyad was to construct an algorithm (make a generalization) from initial information and to use the algorithm to determine if four other unknown household solutions were acids, bases or neither. Task three was scored using the following rubric.

Task 3: 50 points for algorithm that acid or base status based upon color
that vinegar and soda turn.
12.5 points for each unknown solution consistently identified.
Perfect score = 100.

For further information: Zady (1994).

Discourse during the third and most difficult science task was analyzed, and the frequencies of the maternal interaction variables found in Table 1 were noted. The interaction categories were derived from prior work (Portes 1982, 1988, 1991; Portes, Dunham & Williams, 1986).

Table 1 Interaction Categories

V03 Mother open questions

V04 Mother closed questions

V16 Mother or child ask experimenter

V18 Mother imperatives

V19 Mother verbal cue

V20 Mother physical cue

V21 Mother verbal/physical cue

Since instances of mother dealing concretely with the directions were of major importance, maternal interaction variables were specially coded if the action associated with that variable was dependent upon the printed directions. Examples of such dependence were: the mother physically pushed the directions toward the child, the mother read allowed the directions verbatim or closely paraphrased, the mother read aloud imperatives or questions from the directions. (See Note: Coding Manual Item 4). The number of the specially coded occurrences of an interaction variable were divided by the total number of occurrences for that variable giving a dependence percent for that interaction category. For example, imperatives from directions were divided by all imperatives. The higher the percent in that category, the more dependent the mother was on the written directions. The performance in task 3 was also graded for each dyad. The maximum score was 100 points.

Results

The negative correlations found among the dependence percents from Task 3 and the achievement variables (Table 2) indicated that the more direction-dependent the mother, the more likely the dyad was to have a low standardized test performer and/or low task score performance.

Table 2 Correlations between Dependence Percents on Task 3 and Achievement Measures

Interaction Variable	NCES	Score on Task 3
V03 Mother open questions	-.10	-.11
V04 Mother closed questions	-.17	-.26
V16 Mother or child ask experimenter	-.12	-.07
V18 Mother imperatives	-.24	-.36*
V19 Mother verbal cue	-.15	-.41*
V20 M physical cue	-.16	-.20
V21 Mother verbal/physical cue	-.42*	-.38*

NCES = Normal Curve Equivalent for Science *p .05

Additionally, two discriminant function analyses (DFA) were performed. The first used science achievement (1=LO with NCES</= 50, 2=HI with NCES >/= 51) as the dependent variable and the mother interaction dependence percents on Task 3 as the independent variables (p = .01 and tau sq. = .25). The second used the actual score on task 3 (Task 3 Rank where 1= LO with score </= 50 and 2=HI with score >/= 51) as the dependent variable and the mother interaction categories dependence percents as the independent variables (p = .02 and tau sq. = .39). Using the mother dependence percents, the DFA's were able to correctly classify 75 and 81 percent of the cases respectively.

Discussion

The over-dependence upon the directions that the low achievers/low SES mothers

demonstrated may be an indication of their own developmental level. In light of the previously defined construct, we suspect the problem to be directly related to certain activity setting features such as culturally mediated activity, task demands, and the "science" knowledge base required. In this case, the task demand was to read, to understand and to interpret the printed directions. These parents could not meet the task demands. When parents confront school-like tasks that are beyond their proximal development, they tend to use ineffectual mechanisms such as physical cuing or pushing the directions to the child while saying: "Here." Such actions stand in sharp contrast with the elaborated verbal cues so easily employed by the mothers of the high achievers.

We suspect much of the problem here to be literacy related. This is not a simple problem such as reading the newspaper or general decoding, but a higher level literacy problem, as the instructions required some mental facility in moving from concrete to abstract (Purcell-Gates, McIntyre & Freppon, 1995; Bus, van IJzendoorn & Pellegrini, 1995; Stanovich, 1993). This second kind of literacy requirement from parents is not just a question of parent-involvement, an ill-defined construct at present (Cheng-Gorman & Balter, 1997). All these parents were involved to some extent. The problem is not a matter of wanting to or not, but a matter of incapability to mediate which is the source of "cultural" incompatibilities between home and school. In this light, achievement does not involve just the child's ability, but also the parent's own cognitive development in assisting common homework assignments. The mis-match leads to cumulative effects and "socio-cultural retardation" which is gradually constructed in spite of children's competence.

It can be argued that, had the tasks been more culturally relavant for these students and their mothers, perhaps their performance would have improved. Given the new emphasis in

science education on inclusiveness (NSES, 1996), the exclusion of these lower achievers is particularly problematic. Although, making science activities more attractive for students is a goal, there are inherent constants related to this discipline that require the student to adopt a certain orientation and not vice versa. Said another way, one cannot simply invent one's own science and hope to be successful in the post-modern era. However, this study hints that the door to school science will forever be closed to these children, simply because they have literacy problems that reflect the literacy status of their home environments.

In generalizing beyond school, this capacity problem has broader implications for the plight of the low SES--low achieving children, particularly those from certain ethnic groups. When task demands of school outstrip the capabilities of the low SES/achievers, other mediated learning opportunities need to be considered. As the continual mis-matches occur at the level of day-to-day interactions, children's futures are compromised. On the other hand, children who have access to "better" cognitive supports or who live in a "literacy environment" (Sulzby, 1984) develop more capital in school.

The delivery capacity of personnel in the home activity setting and their use of scripts and operations determine how the children will become situated in a broader context of school demands. However the problem may not be that simple. More privileged parents tend to perceive and view projects as opportunities. They have a high sense of efficacy (Bandura,1977; Hoover-Dempsey & Sandler,1997). The mothers of higher achievers in this study admitted to or demonstrated participation in science activities with their children at home. Several of these mothers likened the third task to testing the water in their home swimming pools. Again showing these parents' familiarity with the task demands and facility in using mediational tools. Low SES parents of low achievers generally doubt their abilities. These doubts are often reconstructed in their children.

But how does this scenario play itself out? The answer is in the match between activity

setting variables and the school setting. School activities may put personnel at home and school in a bind, outstripping their capacity to assist development. From this study then, it appears that parental involvement is not just motivational, but more importantly, a strategic issue that concerns mediational means.

Given the United States is trailing many other countries with respect to achievement, this study documents some of the basic problems which "lock out" a substantial segment of the population from subsequent opportunities, i.e., to have equal educational opportunity. In the area of science, the problem is possibly clearer. Even when parents want to help their children or to be involved, the lack of theoretical knowledge and the difference in "out of school" factors show up. Here school inevitably serves as an amplifier of inequality in educational opportunity. It is clear that alternative ways of providing access to mediated experiences (such as year-round schooling in culturally rich contexts, increasing the adult-to-child ratio with classroom volunteers from the community or a national service initiative for college students tied to loan forgiveness) need to be constructed in schooling children for a democratic society.

Note: Coding Manual Item 4

4. BOX numbers which have anything to do with directions (verbal or physical)

(The idea is to document M/C reliance on the written directions/description. Once M/C start filling in charts, they are relying on their own production, not just the written directions.)

e.g. M pushes directions toward C: code M directs attention physically

e.g. M reads directions verbatim or paraphrased: code verbal cue (V cue)

e.g. M questions "Does it say soda is a base?" (paraphrased from directions which state: "Soda is a base.") code close ended questions

e.g. M reads aloud a statement from the directions: "Make all the possible pairs an imperatives

BUT NOT in the process of filling in charts, or pointing to charts in progress, writing descriptions or reading silently.

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